SAMPLING EQUIPMENT 8.3

Equipment used to collect and process bottom-material samples is described below. Field personnel must understand the limitations of the equipment selected, decide which equipment will give the best results for the procedures selected, and be thoroughly familiar with equipment operation before starting field work. The decontamination and storage procedures for sampling equipment described in 8.3.2 are necessary to prevent contamination of samples.

EQUIPMENT SELECTION 8.3.1

Equipment selected must meet data-collection objectives. Be aware that no bottom-material sampling equipment is appropriate for every objective and environmental setting. Most bottom-material samplers were designed primarily for the collection of bottom-material samples for benthic-invertebrate or particle-size analysis and generally are not adequate for collecting undisturbed samples for chemical and mineralogical analysis. Most bottom-material samplers are particularly unsuited for collecting samples from the critical water-sediment interface. Characteristics of the more common bottom-material samplers are listed in table 8-2. Additional information on bottom-material samplers and sampling equipment is provided in Sly (1969), U.S. Geological Survey (1978), Plumb (1981), Edwards and Glysson (1988), Norris (1988), Ward and Harr (1990), Horowitz (1991), Mudroch and MacKnight (1994), and Mudroch and Azcue (1995).

When selecting bottom-material sampling equipment, consider:

- Safety of the field team—Safety always takes precedence.
- Sampling platform and (or) access to sampling site (boat, ship, float plane, helicopter, ice, bridge, scuba, wading, cableway).
- Physical character of cross-sectional area (such as size, velocity, slope, bathymetry, and sampling area depth).
- Physical character of bottom material (such as particle size, organic content, degree of consolidation).

- Sampling equipment limitations (with respect to physical disturbance of bottom, retention of fines, degree of sample compaction or induration, penetration depth, grain-size sampling efficiency, portability).
- Winch system operation (ideally should be capable of free-fall and controlled descents).
- Sample size and weight.
- Target analytes (materials used to construct equipment can leach or be abraded and can measurably affect results of sample analysis). Determine appropriate construction materials based on target analytes.
  - Inorganic analytes. All equipment parts that come in contact with a sample must be composed of uncolored or white polypropylene, polyethylene, polyfluorocarbon, or other suitable non-metallic material.
  - Organic analytes. All equipment parts that come in contact with a sample must be composed of uncolored polyfluorocarbon, metal, or glass.

Data from bottom-material samples collected with different devices may not be comparable.

8.3.1.A Samplers

Two commonly used samplers for collecting bottom materials are grab samplers and core samplers (table 8–2). Dredge samplers are not recommended for use in water-quality studies, primarily because they provide inadequate control of sample location and depth.

Grab Samplers

- Grab samplers are recommended for only very slow-flowing and still water.
- Grab samplers are used for collecting surficial bottom material for temporal and spatial comparisons.
- Grab samplers are susceptible to washout of fine material and dispersion of material in front of the pressure wave created by the sampler.

Core Samplers

- Core (hand, gravity, and piston) samplers are used to collect bottom material for temporal and spatial comparisons.
- Core samplers are susceptible to washout of material, dispersion of material in front of the pressure wave created by the sampler, and compaction of material.

Sieves 8.3.1.B

Bottom-material samples collected for chemical analysis are typically sieved to separate them into various target particle-size fractions. Size-fractionation equipment and procedures vary depending on whether target analytes are inorganic or organic and on the size fraction targeted. Typically, sieves are available with approximately a 76-, 203-, or 305-mm (3-, 8-, or 12-inch) diameter in half, full, or deep stacking height. Sieves usually are constructed with a brass frame and brass or stainless steel wire fabric mesh, stainless steel frame and wire fabric mesh, or high-density polyethylene or nylon frame with either nylon, polyethylene, or polyester monofilament fabric mesh. Nylon fabric mesh can stretch in water. Metallic sieves generally are available with sieve openings from 100 to 0.0020 mm (or approximately 4 to 0.00008 inch). Plastic sieves generally are available with sieve openings from 3.35 to 0.0020 mm (0.132 to 0.00008 inch). Sieves that meet American Society for Testing and Materials (ASTM) E-11 specifications are recommended. Monofilament fabric mesh, however, can have thread diameters and average openings that can vary substantially from ASTM E-11 specifications for metallic fabric.

- Inorganic analytes. Use a non-metallic sieve frame and polyester, polyethylene, or nylon monofilament mesh to process bottom material for samples that will be analyzed for metals and metalloids. Use utensils and containers composed of non-metallic material (polyfluorocarbon or other uncolored plastic) for metal and metalloid sample processing.
- Organic analytes. Use stainless steel equipment (frame and mesh of sieve, utensils, and containers) to process bottom-material samples that will be analyzed for organic compounds. Brass sieves are acceptable but brass is not the preferred construction material.

Table 8–2. General characteristics of selected grab and core samplers

[Penetration depth, sample volume, and applications are presented in English units because equipment is constructed to English-unit specifications: 1 inch = 2.54 centimeters, 1 pound = 0.4536 kilogram, 1 foot = 0.3048 meter. D, diameter; L, length; W, width; PDC, plastic dip coated; *, trade name; I.D., inside diameter; na, not applicable; mm, millimeter; ft, feet; SS, stainless steel; PVC, polyvinyl chloride; ft/s, feet per second; <, less than]

Sampler designation	Sampler construction material	Sampler dimensions (inches)	Sampler weight (pounds)	Suspension	Penetration depth (inches)	Sample volume (cubic inches)	Application
Grab Samplers							
USBMH-53	SS body, brass piston	2 D x 8 L	7.5	46-inch-long rod	0–8	0–25	Wadable water, loosely consolidated material less than 0.063 mm.
USBMH-60	Cast aluminum body, SS rotary scoop, rubber gasket	8 x 4.5 x 22	32	Hand line or winch and cable	0–1.7	0–10.7	Wadable to water of slow velocity (<1 ft/s) and moderate depth; firm unconsolidated to loosely consolidated material, less than 16 mm; PDC version available; sampler must be equipped with safety yoke.
USBMH-80	SS rotary scoop	2.75 D x 3.25 W	8	56-inch-long rod	0–1.75	0–10.7	Wadable water; unconsolidated to loosely consolidated material, less than 16 mm.
USBM-54	Cast steel body, SS rotary scoop, rubber gasket	8.5 x 7 x 22	100	Winch and cable	0–1.7	0–10.7	Water of moderate velocity and depth; firm unconsolidated to loosely consolidated material, less than 16 mm; PDC version available, sampler must be equipped with safety yoke.
Ponar * (2 sizes)	SS body, zinc-plated steel weights and neoprene flaps	6x6 or 9x9	15–22 or 45–60	Hand line or winch and cable	0–4	0–146.4 or 0–500	Weight dependent; wadable to water of slow velocity (<1 ft/s) and moderate depth; unconsolidated to loosely consolidated material, less than 16 mm; susceptible to loss of fines.
Petersen*	Zinc-plated steel	12 x12	39–93	Hand line or winch and cable	0–12	600	Weight dependent; wadable to water of slow velocity and moderate depth; unconsolidated to consolidated material, less than 16 mm; susceptible to loss of fines.

Table 8–2. General characteristics of selected grab and core samplers—*Continued*

Sampler designation	Sampler construction material	Sampler dimensions (inches)	Sampler weight (pounds)	Suspension	Penetration depth (inches)	Sample volume (cubic inches)	Application
Grab Samplers—*Continued*							
Birge-Ekman* (4 sizes)	SS or brass	6x6x6 or 6x6x9 or 9x9x9 or 12x12x12	16–25 or 21–35 or 47–68 or 100–150	Rod, hand line, or winch and cable	0–3 or 0–4 or 0–5 or 0–6	0–216 or 0–323 or 0–729 or 0–1,726	Wadable to water of slow velocity (< 1 ft/s) and moderate depth; soft unconsolidated material, less than 0.25 mm; susceptible to loss of fines; must penetrate perpendicular.
Shipek*	Cast alloy steel	4 x 6 x 6 or 18.6 × 25.1 × 17.4	11 or 135	Hand line or winch and cable	0–1.2 or 0–4	0–30.5 or 0–183	Wadable to water of moderate velocity and depth; unconsolidated to consolidated material, less than 0.50 mm; susceptible to loss of fines; PDC version available.
Van Veen* (2 sizes)	SS body, zinc-plated steel chain, neoprene flaps	13.8 x 27.6 or 19.7 x 39.4	66–88 or 143–187	Cable	0–12	0–11 or 0–46	Wadable to water of moderate velocity and depth; soft unconsolidated material less than 0.25 mm.
Core Samplers							
Hand	SS or SS core tubes; Lexan* or SS nose piece and SS or plastic core catcher	2 I.D. 20–96 L	10–60	Handle 0–15 ft. L	0–96	0–300	Wadable to diver application, water of slow velocity (< 1 ft/s); soft to semi-firm unconsolidated material less than 0.25 mm; 2-inch core liners available in plastic and SS.
Ogeechee* (sand corer)	SS or SS core tubes; Lexan or SS nose piece and SS or plastic core catcher	2 I.D. 20–96	10–60	Hand corer	0–96	0–300	Wadable to diver application, water of slow velocity (< 1 ft/s) and depth; soft to firm unconsolidated material less than 0.50 mm; 2-inch core liners available in plastic and SS.
Kajak-Brinkhurst [K-B]* (gravity corer)	SS, Lexan, or SS core tubes; Lexan or SS nose piece; SS or plastic core catcher; neoprene valve	2 I.D. 20, 30 L	15–48	Hand line or winch and cable	0–30	0–90	Water with very slow velocity (< 1 ft/s); loosely consolidated material less than 0.063 mm; 2- inch core liners available in plastic and SS.

Table 8–2. General characteristics of selected grab and core samplers—*Continued*

Sampler designation	Sampler construction material	Sampler dimensions (inches)	Sampler weight (pounds)	Suspension	Penetration depth (inches)	Sample volume (cubic inches)	Application
Core Samplers—*Continued*							
Phleger* (gravity corer)	SS core tube, nose piece, core catcher; neoprene valve	1.4 I.D. 20 L	17.6–33	Hand line or winch and cable	0–20	0–40	Water with very slow velocity (< 1 ft/s); soft to firm unconsolidated material less than 0.50 mm; core liners available in plastic.
Ballchek* (gravity corer)	Bronze head, SS or PVC core tubes; Lexan* or SS nose piece and SS or plastic core catcher; plastic/ polyurethane valve	2–5 I.D. 30–96 L	Variable depending on size and construction material	Hand line or winch and cable	0–96	0–750	Water with very slow velocity (< 1 ft/s); loosely consolidated material, less than 0.063 mm; core liners available in plastic and SS.
Benthos* (gravity corer)	Steel core tube, nose piece, and core catcher	2.6 I.D. 120 L	55–320	Winch and cable	120	0–490	Water with very slow velocity (< 1 ft/s); loosely consolidated material less than 0.063 mm; core liners available in plastic.
Alpine* (gravity corer)	Steel core tube, nose piece, core catcher, and neoprene valve	1.6 I.D. 72 L	242–342	Winch and cable	72	0–180	Water with very slow velocity (< 1 ft/s); loosely consolidated material, less than 0.063 mm; core liners available in plastic; inconsistent vertical penetration.
Box	SS with optional acrylic box liner	6 x 6 x 9	31–100	Winch and cable	9	0–300	Water of slow velocity (< 1 ft/s) and moderate depth; unconsolidated material, less than 0.25 mm.
Piston	SS or plastic core tubes; Lexan or SS nose piece; SS or plastic core catcher	1–5 I.D. 40–800 L	25–500	Hand line or winch and cable	0–80	0–6,200	Water with very slow velocity (< 1 ft/s); loosely consolidated material, less than 0.25 mm; core liners available in plastic.
Vibracorer*	Variable	2–3 I.D. 40–500 L	100–300	Frame	0–500	0–2,300	Water with very slow velocity (< 1 ft/s); loosely consolidated material, less than 16 mm; assembly might require scuba divers.